A Revision of the Pediculate Fishes of the Genus *Malthopsis* Found in the Waters of Japan (Family Ogcocephalidae)

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Fishes of the genus *Malthopsis* are for the most part rarely caught and little known. Since the genus was erected by Alcock in 1891 for the accommodation of *Malthopsis luteus*, about twelve species have been described by several authors from the Indo-Pacific region. From Japanese waters, Jordan (1902: 378–379) described a new species, *Malthopsis tiarella*, based on a specimen taken from Suruga Bay, when he revised the pediculate fishes or anglers of Japan. Then, Tanaka reported two new species, *Malthopsis annulifera* (1908: 44) and *Malthopsis kobayashii* (1916: 348) from the Bay of Sagami and Ise (?), respectively. Subsequently, the occurrence of *Malthopsis mitrigera* Gilbert and Cramer and *Malthopsis lutea* Alcock were reported by Kamohara (1936*a:* 22; 1936*b:* 935) on the basis of specimens obtained from Tosa.

The classification of the group, which has been based on rather unstable morphological features of these fishes, is still far from being satisfactorily understood. For instance, *M. annulifera* and *M. kobayashii* have been synonymized with *M. tiarella* by Tanaka (1931: 43) and also by Kamohara (1934*a:* 194–195; 1934*b:* 1202); further, *M. mitrigera*, *M. tiarella*, *M. annulifera*, and *M. kobayashii* have been united with *M. lutea* by Kamohara (1937*a:* 13; 1937*b:* 119–121). On the other hand, Okada and Matsubara (1938: 458–459), although agreeing in general with Kamohara's treatment, have separated *M. mitrigera* from *M. lutea*. Recently, Kamohara (1950: 277–278; 1952: 103–104) altered his previous view and distinguished the four species based on the general form of the subopercular spine and the number of dorsal fin rays.

Lately the present authors have examined a rather large number of specimens, which are referable to the genus *Malthopsis*, taken by deep-sea trawlers off the Pacific coast of Japan at a depth of about 100 fathoms and deposited in the Department of Fisheries, Faculty of Agriculture, Kyoto University. We have finally come to the conclusion that they represent five distinct species, *M. mitrigera*, *M. annulifera*, *M. lutea*, *M. tiarella*, and *M. jordani* Gilbert, the last of which has never been obtained from Japanese waters.

In this paper, the body length is indicated by a measurement from the tip of the lower jaw to the base of the caudal fin; the disk length is measured from the tip of the lower jaw to the vent; the greatest breadth of the disk is recorded as a distance between the outermost points of the most prominent subopercular spines; the tail width is measured at the beginning of the anal fin; and the rostral spine length is the distance from its tip to a line drawn across the anterolateral sides of the disk as in Figure 1. In order to determine the size of the dark ring-like mark-

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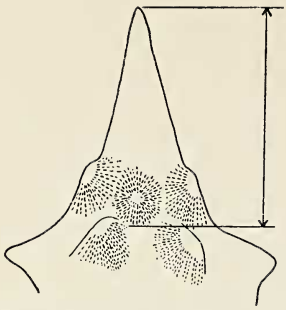

FIG. 1. Diagram showing the measurement used as the length of the rostral spine.

ings, the area of a marking at the right side of the disk and nearest to its midline, is calculated by the planimeter. Teeth are cleared in potassium hydroxide and stained with alizarine red.

We wish to express our sincere gratitude to Professor Kiyomatsu Matsubara for his kind supervision during the course of this study. We are also greatly indebted to Dr. Yaichiro Okada and Mr. Kiyoshi Suzuki for their kindness in sending us several valuable specimens taken from the Kumano Nada. The expenses for executing the studies of the present series were defrayed from the research fund of Kyoto University by Keizo Shibusawa from 1943 to 1945 and by the Ministry of Education from 1950 to 1953.

SYSTEMATIC SIGNIFICANCE OF VARIOUS BODY CHARACTERS

FIN RAYS: The rays in the dorsal and pectoral fins differ in number in certain cases, and are of some importance in the classification of the species of *Malthopsis* (Table 1). The counts of dorsal rays are generally 5 in *M. mitrigera*, *M. annulifera*, and *M. lutea* and 6 in *M. jordani* and *M. tiarella* (in holotypes of *M. jordani* and *M. tiarella* this count is 6 and 7, respectively). The count of pectoral rays is 11–13 and usually 12 in *M. annulifera*, *M. lutea*, and *M. tiarella*, but the count is generally 13 in *M. jordani* and 13–15 in *M. mitrigera*.

MARKINGS: Color markings on the upper surface of the disk are valuable in distinguishing some of the species of *Malthopsis* (Table 2). There are no discernible markings in specimens of *M. mitrigera*. Irregular blackish brown specks are found in *M. tiarella*. About half of our specimens of *M. jordani* and *M. lutea* are unmarked, while the others in each of these species are provided with blackish ring-like markings on each side of the median line of the disk. In the specimens of *M. annulifera*, 5–12 ring-like markings are present on the dorsal surface of the disk. The intraspecific variability of the size of ring-like markings is rather prominent, but it is evident from Figure 2 that the relative size of marking at a given standard length is largest in the specimens of *M. lutea*. The markings are larger in *M. annulifera* than in *M. jordani*.

DERMAL OSSICLES: The surface of the body is completely covered with dermal ossicles. Some of these are enlarged and tubercular in shape and are herein called bony tubercles. In this paper we have taken up the arrangement of bony tubercles on the dorsomedian portion of the disk. A row of the tubercles set on the median line of the upper surface of the disk is the so-called median row. Rows

TABLE 1
DORSAL AND PECTORAL FIN RAY COUNTS IN FIVE SPECIES OF MALTHOPSIS FROM JAPAN

SPECIES	DORSAL FIN RAYS			TOTAL	PECTORAL FIN RAYS					TOTAL
	4	5	6		11	12	13	14	15	
M. mitrigera	1	5	..	6	..	..	2	3	1	6
M. jordani	..	3	4	7	..	1	5	1	..	7
M. annulifera	2	23	..	25	1	19	6	..	..	26
M. lutea	..	32	2	34	4	30	..	..	..	34
M. tiarella	..	..	2	2	..	2	..	..	..	2

of the tubercles running backward from the postorbital rim to a tubercle of the median row are named mediolateral rows. The number and size of the tubercles of these rows, and the point of junction of the median row and the mediolateral rows, are the most valuable characters in the taxonomy of this group.

Particular attention, hitherto, has not been paid to the dermal ossicles on the ventral surface of the disk, but we have found that the mode of their arrangement and their relative size are useful for the classification of this group, though such features are somewhat unstable.

SUBOPERCULAR SPINE: Attention is drawn to the direction of protrusion of the subopercular spine and the number and direction of the prominent spinules at the tip.

CIRRI: So far as descriptions and figures of the fishes of this group are concerned, the dermal cirri which are present on the outer sides of the body have never been noted by any researchers. We have carefully observed material in the water, and consequently we have found that some of the specimens in *M. annulifera* and *M. lutea* are provided with very feeble cirri on the outer side of the body. We cannot tell for certain whether or not the other three species of this group have the cirri, for they are very feebly developed and might be torn off at the time of preservation.

SIZE: Absolute size of the body is an important taxonomic feature. *M. jordani* is the largest form in this group, reaching 140 mm. in total length, and even the smallest specimen we have observed is nearly 100 mm. in entire length. *M. mitrigera*, *M. lutea*, and *M. tiarella* are much smaller and even the largest specimen is not more than 100 mm. On the other hand, *M. annulifera* is moderately large and attains a total length of 118.5 mm., based on our observations.

DISTRIBUTION: The fishes of this group, in general, are rather rare in Japan. Although they are very frequently taken by motor trawlers on the Pacific coast of middle and southern Japan, they have never been obtained from either northern Japan or the Sea of Japan. Of the species, *M. annulifera* and *M. lutea* are commoner than the others. It is assumed that these two species may presumably be living in similar ecological conditions, because in many cases thay are obtained together. *M. jordani* and *M. mitrigera*

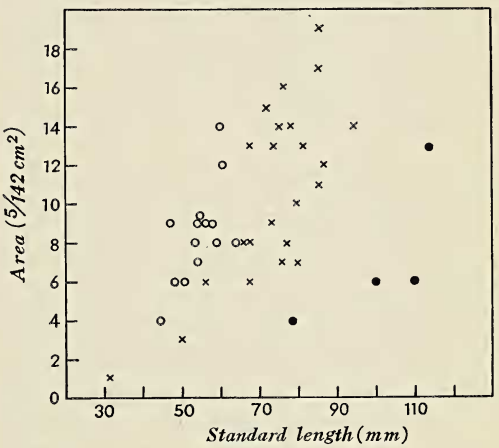

FIG. 2. Relation between standard length and the size of ring-like marking in three species of *Malthopsis*. ○, *M. lutea*; ×, *M. annulifera*; ●, *M. jordani*.

TABLE 2
FREQUENCY DISTRIBUTION OF THE NUMBER OF RING-LIKE MARKINGS ON THE DORSAL SURFACE OF THE DISK IN FOUR SPECIES OF MALTHOPSIS

SPECIES	NUMBER OF MARKINGS PRESENT												
	0	1	2	3	4	5	6	7	8	9	10	11	12
M. mitrigera..	7	..	..	..	..	..	..	..	..	..	..	..	..
M. jordani...	3	..	2	..	1	1	..	..	..	..	..	..	..
M. annulifera.	..	..	..	..	..	3	7	8	4	2	..	..	2
M. lutea.....	16	..	5	1	3	..	3	1	3	..	..	..	..

are rare, although specimens of these species are frequently obtained with those of *M. annulifera* and *M. lutea*. *M. tiarella* is very rare and we have been favored with only two specimens taken from off Owasi and Kôchi. The specimens of this group taken off Owasi on January 19, 1937, by K. Matsubara contained four different species but not *M. annulifera*.

TAXONOMY

KEY TO THE SPECIES OF *Malthopsis*

1a. Subopercular spine greatly produced laterally, bearing 4 obvious spinules, 2 of them directed forward and 2 backward; ventral surface of disk covered with radially striated bony tubercles as large as those of dorsal surface; band of vomerine teeth elongated transversely, rectangular; peritoneum dusky; tail very slender, the width usually more than 10.0 in standard length; dorsal surface of disk without markings . . . . . **mitrigera**

1b. Subopercular spine neither greatly protruding outward nor ending in 4 obvious spinules, antrorse spinule either single or wanting; ventral surface of disk covered with minute tubercles; the patch of vomerine teeth rather quadrangular; peritoneum pale; tail moderately thick, the width usually less than 10.0 in standard length; dorsal surface of disk with or without markings 2

2a. Subopercular spine directed outward with a projecting antrorse spinule at the tip; ventral surface of disk sparsely covered with rather small bony tubercles 3

2b. Subopercular spine directed outward and backward, forming a triangular process, without a projecting antrorse spinule at the tip; ventral surface of disk thickly covered with minute bony prickles 4

3a. Bony tubercles on dorsal surface of disk pointed and but slightly granulated, forming 3 rows on forehead; mediolateral rows of tubercles joined to median row at posterior portion of disk; bony tubercles lying between vent and pelvic fins continuous . . . . . **jordani**

3b. Bony tubercles on dorsal surface of disk rather pointed and noticeably granulated, forming 2 rows on forehead; mediolateral rows joined to median row at anterior portion of disk; bony tubercles lying between vent and pelvic fin few, scattered . . . . . **annulifera**

4a. Bony tubercles on dorsomedial surface forming 3 or more rows on forehead; dorsal surface of disk with or without ring-like markings; dorsal rays usually 5 . . . . . **lutea**

4b. Bony tubercles on dorsomedial surface forming 2 rows on forehead; dorsal surface of disk without ring-like markings, but with scattered blackish brown specks; dorsal rays 6 or 7 . . . . . **tiarella**

Malthopsis mitrigera Gilbert and Cramer

Kagi-furyu-uo (Japanese name)

Figs. 3, 4

Malthopsis mitrigera Gilbert and Cramer, 1896: 434–435, pl. 48, figs. 1–2; Jordan and Evermann, 1905: 524–525, fig. 229; Gilbert, 1905: 695; Fowler, 1934: 450; Kamohara, 1936*a*: 22; Okada and Matsubara, 1938: 458; Kamohara, 1950: 287; Kamohara, 1952: 103.

Malthopsis triangularis Lloyd, 1909: 169, pl. 45, figs. 1–1a; Barnard, 1927: 1009; Smith, 1949: 427, fig. 1227.

Malthopsis lutea (*partim*) Kamohara, 1937*a*: 13, pl. 2, fig. 5.

MATERIAL EXAMINED: Nos. 4156, 4157, 4162, 4165, 4930, and 4932 (the numbers refer to Matsubara's Fish Collection), 29.0–61.0 mm. in standard length (32.0–74.0 mm. in total length), off Owasi, Mie Pref., January 19, 1937; No. 15169, 73.0 mm. (86.5 mm.) off Owasi, January 18–20, 1950.

D. 4–5; A. 4; C. 9; P. 13–15; V. 1, 5. Disk length 1.79–1.98 (1.85) in standard length; disk width 1.04–1.26 (1.12); tail width 10.20–

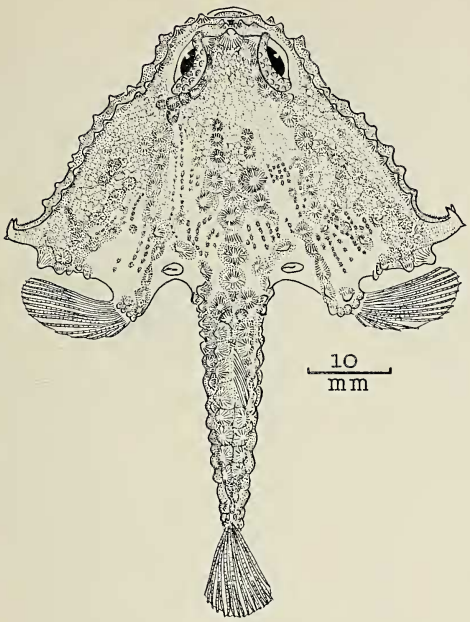

Fig. 3. Dorsal aspect of *Malthopsis mitrigera* (specimen no. 4157, 58.0 mm. in standard length).

13.22 (11.15). Disk width 0.55–0.71 (0.61) in disk length; eye diameter 3.37–4.60 (4.05); interorbital width 4.25–6.30 (5.21); rostral spine 8.40–10.80 (9.51); mouth width 2.84–3.72 (3.47); pectoral fin 1.98–2.60 (2.32); pelvic fin 2.31–3.54 (2.70).

Disk very broad, the greatest width slightly less than the length of body. Tail slender and short. Rostral spine nearly vertical or directed somewhat obliquely upward, the length nearly equal to or less than half the diameter of eye.

Dorsal surface of disk thickly covered with many dermal ossicles except for both opercular and shoulder regions; some of them enlarged and quite regular in their arrangement; radial striations of bony tubercles minute, smooth, but finely serrate when viewed through a lens (Fig. 4c); mediolateral rows each represented by 2 or 3 rather prominent tubercles; median row of tubercles beginning at the middle part of disk, leaving therefore a rather smooth space along the median line of forehead; each side of the first tubercle on median row armed with 1 or 2 noticeable tubercles. Three rows of tubercles running along the anterolateral margin of disk, the upper row beginning at the posterodorsal part of upper jaw and bending slightly upward at the under side of posterior rim of orbit. Bony tubercles on ventral surface enlarged and in contact with each other; vent in center of a naked area of skin, surrounedd by an elliptical basin with several tubercles; a double row of tubercles runs from base of pectoral fin to base of pelvic fin; an enlarged tubercle in front of pectoral fin, surrounded by several smaller ones; small dermal ossicles, moreover, scattered irregularly on thoracic region (Fig. 4A_1, A_2). Rest of ventral surface of disk naked. Tail completely surrounded with large bony tubercles.

Subopercular spine flattish, strongly protruding, bearing 4 obvious spinules at the tip, 2 of these distinctly directed forward, the other ones variable in size but smaller and directed outward and backward (Fig. 4B_2); in young specimens, however, the spine is not so strongly protruded as in adults (Fig. 4B_1).

Sides of body without dermal cirri. Longest anal ray usually not reaching to base of caudal when the fin is laid back.

Band of vomerine teeth elongated laterally in form of rectangle (Fig. 4E); patch of teeth on palatine rather small and circular (Fig. 4E); teeth on tongue in 2 broad parallel bands, their posterolateral regions not divergent (Fig. 4D).

Color, in formalin, uniformly yellowish brown above, without any markings; pale below; fins also pale; peritoneum dusky.

REMARKS: Our specimens thus far examined agree well with the original description of this species given by Gilbert and Cramer (1896: 434–435, pl. 48, figs. 1–2), except for the more numerous branchiostegal rays (5 instead of 4) and somewhat shorter tail. *Malthopsis triangularis* Lloyd (1909: 169, pl. 45, figs. 1–1a) should be included in the synonymy of this species inasmuch as there is no obvious difference which will enable us to distinguish

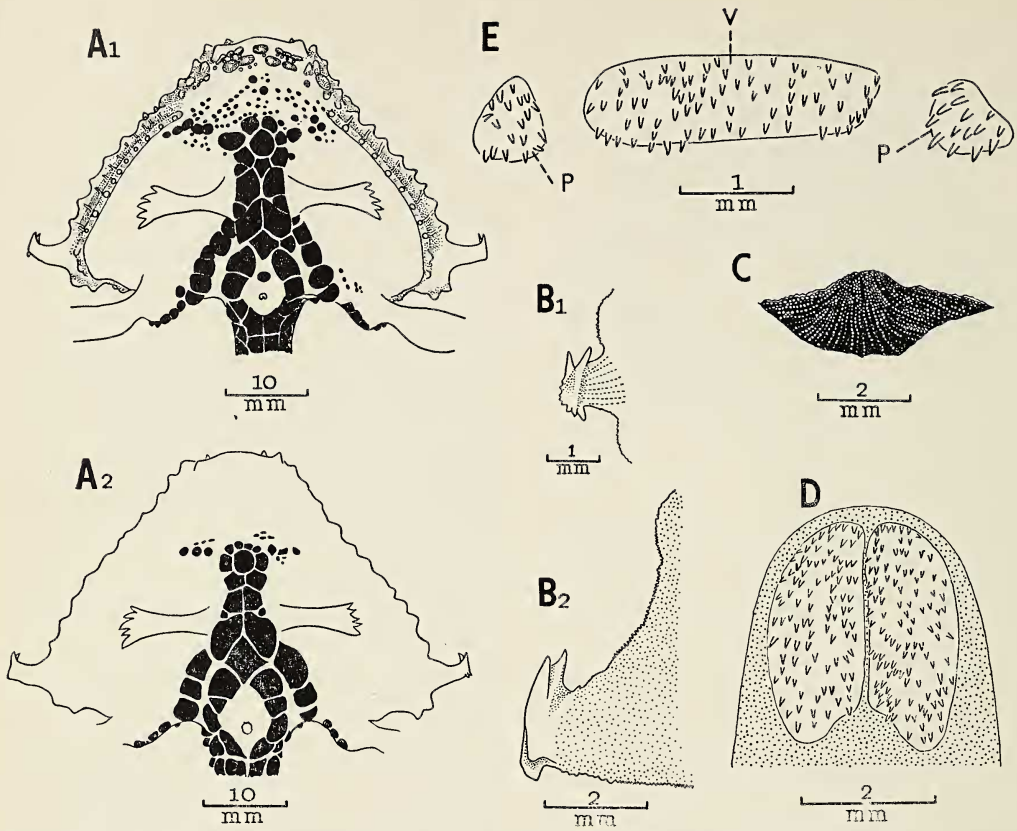

FIG. 4. *M. mitrigera:* A_1, ventral aspect of disk; A_2, bony tubercles on ventral surface of disk; $B_{1,2}$, subopercular spine of young and mature specimens; C, lateral aspect of bony tubercle in median line of dorsal surface of disk; D, dorsal surface of anterior part of tongue; E, teeth on vomer (V) and palatine (P). A_1 drawn from a specimen, 58.0 mm. in standard length (specimen no. 4157); A_2, from a specimen, 55.0 mm. in standard length (specimen no. 4930); B_1, from a specimen, 29.0 mm. in standard length (specimen no. 4932); B_2, C, D, and E, from a specimen 61.0 mm. in standard length (specimen no. 4162).

it. Of the specimens belonging to Lloyd's types (1909: 175–176, pl. 48–49), W (with the arrangement of the dermal armature on body orderly and the disk width medium), X (with the dermal armature orderly and the disk narrow), and Z (with the dermal armature orderly and the disk broad) are all identical with this species.

Malthopsis jordani Gilbert
Kowanuke-furyu-uo (new Japanese name)
Figs. 5, 6

Malthopsis jordani Gilbert, 1905: 695–696, pl. 100; Jordan and Seale, 1906: 438; Böhlke, 1953: 148.

Malthopsis lutea (*partim*) Kamohara, 1937*a:* 13, pl. 2, fig. 4.

MATERIAL EXAMINED: No. 1629, 101.0 mm. (125.0 mm.), off Owasi, Mie Pref., December 6–9, 1935. Nos. 4152 and 4154, 88.5–113.5 mm. (112.0–140.0 mm.), off Owasi, January 19, 1937. No. 6798, 86.5 mm. (108.5 mm.), off Heta, Shizuoka Pref., November 22–24, 1938. No. 19062, 78.5 mm. (98.0 mm.), off Owasi, November 12–17, 1952. Nos. 20513 and 20514, 100.0–110.0 mm. (121.5–135.0 mm.), off Miya, Aichi Pref., April 8, 1953.

D. 5–6; C. 8–9; P. 12–14; V. 1, 5. Disk length 1.65–1.79 (1.71) in standard length; disk width 1.29–1.45 (1.37); tail width 7.69–

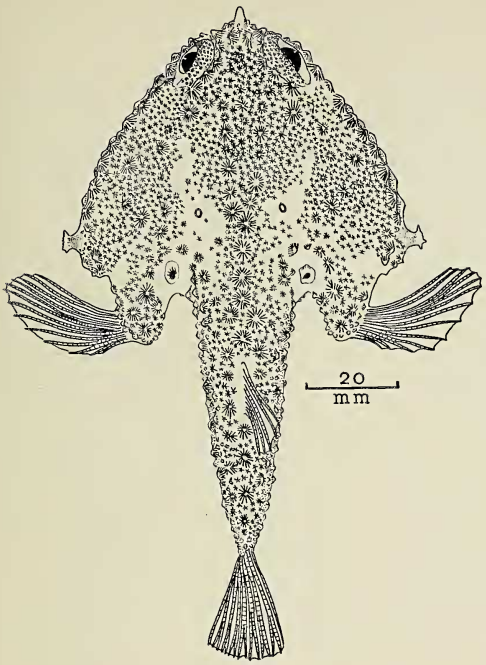

Fig. 5. Dorsal aspect of *Malthopsis jordani* (specimen no. 20513, 110 mm. in standard length).

8.63 (7.99). Disk width 0.77–0.82 (0.80) in disk length; eye diameter 4.28–5.95 (5.03); interorbital width 6.20–8.21 (7.09); rostral spine 8.91–13.70 (10.24); mouth width 3.68–4.46 (4.03); pectoral fin 2.30–3.12 (2.66); pelvic fin 2.46–3.12 (2.66).

Disk broad, the greatest width somewhat less than length of body. Tail rather slender and short. Rostral spine directed forward or forward and slightly upward, nearly half as long as diameter of eye.

Dorsal surface of disk rather thickly covered with dermal ossicles except for both opercular and shoulder regions; some of them enlarged, pointed and quite regular in their arrangement, radial striations of bony tubercles prominent, rather smooth but slightly granulated (Fig. 6C); mediolateral rows each represented by several tubercles, joined to median row of tubercles at posterior portion of disk; median row of tubercles developed throughout the entire length of disk, but the tubercles between those of the mediolateral

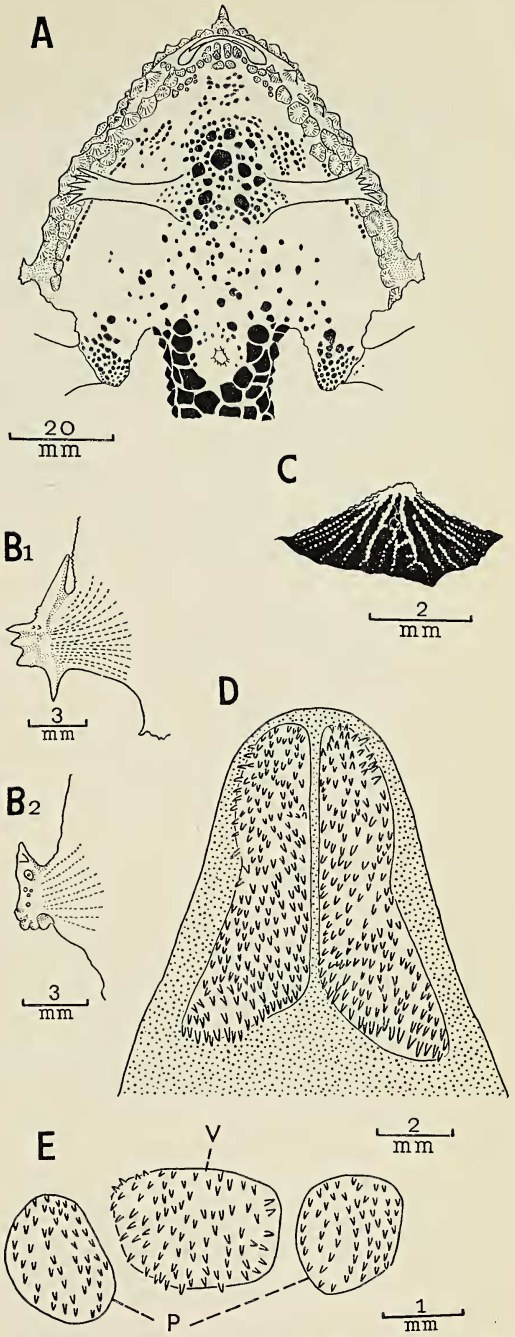

Fig. 6. *M. jordani:* A, ventral aspect of disk; $B_{1,2}$, subopercular spine; C, lateral aspect of tubercle in median line of upper surface of disk; dorsal surface of anterior part of tongue; E, teeth on vomer (V) and palatine (P). A, from a specimen, 110.0 mm. in standard length (specimen no. 20513); B_1, from a specimen, 78.5 mm. in standard length (specimen no. 19062); B_2, from a specimen, 110.0 mm. in standard length (specimen no. 20514); C, D, and E, from a specimen, 86.5 mm. in standard length (specimen no. 6798).

rows scarcely enlarged. Three rows of tubercles running along the anterolateral margin of disk, the upper beginning at the posterior part of upper jaw, and turning sharply upward at the under side of posterior rim of orbit. Ventral surface of opercular region largely smooth, but the other parts with scattered tubercles which are flatter and smaller than those of dorsal surface; several tubercles between pelvics enlarged; small tubercles, moreover, scattered from thoracic to posterior edge of disk (Fig. 6A). Tail completely surrounded with large or small tubercles.

Subopercular spine short, protruding; the tip armed with projecting spinules, one of them prominent, directed forward (Fig. $6B_1$, B_2).

Sides of body without dermal cirri. Longest anal ray reaching to or beyond the base of caudal when the fin is laid back.

Patches of vomerine and palatine teeth rather large, circular or quadrangular (Fig. 6E); teeth on tongue in two broad parallel bands, their posterolateral regions widely divergent (Fig. 6D).

Color, in formalin, yellow above, with or without black ring-like markings (of 7 specimens examined, 4 had 2 or 5 rings, the other 3 had none). Dermal ossicles on back brownish along their base and striations; ventral surface of body pale; a dark band crossing near the end of caudal; pectoral and dorsal dusky; pelvic and anal pale; peritoneum also pale.

Malthopsis annulifera Tanaka
Wanuke-furyu-uo (Japanese name)
Figs. 7, 8

Malthopsis annulifera Tanaka, 1908: 44, pl. 1; Jordan, Tanaka and Snyder, 1913: 428; Kamohara, 1950: 287, fig. 220; Katayama, 1950: 12; Kamohara, 1952: 103–104, fig. 100.

Malthopsis ocellata Smith and Radcliffe *in* Radcliffe, 1912: 207–208, pl. 18, fig. 1, pl. 19, fig. 1.

Malthopsis tiarella (*partim*) Kamohara, 1934*a:* 194–195, figs. 2–3.

MATERIAL EXAMINED: Nos. 1630–1632, 1634 and 1638, 50.0–81.5 mm. (63.0–101.0 mm.), off Owasi, Mie Pref., December 6–9, 1935. No. 2031, 31.5 mm. (40.5 mm.), off Owasi, April 13, 1936. Nos. 4134–4135, 4158 and 4295, 66.0–76.0 mm. (83.5–93.0 mm.), off Owasi, January, 1939. No. 4680, 56.0 mm. (69.5 mm.), off Owasi, December 1936. No. 4916, 94.5 mm. (118.5 mm.), off Owasi, February 3, 1938. No. 15171, 67.5 mm. (84.5 mm.), off Owasi, January 18–20, 1950. No. 17637, 77.0 mm. (95.5 mm.), off Miya, Aichi Pref., March 15, 1952. Nos. 19063–19064 and 19202, 73.0–85.5 mm. (93.5–108.0 mm.), off Owasi, November 12–17, 1952. Nos. 19675 and 19676, 75.0–85.0 mm. (94.0–104.0 mm.), off Nobeoka, Miyazaki Pref., December 10, 1952. Nos. 20515 and 20516, 72.0–76.0 mm. (91.5–93.0 mm.), off Miya, April 8, 1953. No. 20821, 80.0 mm. (101.0 mm.), locality and date unknown. Nos. 21072–21073, 82.0–

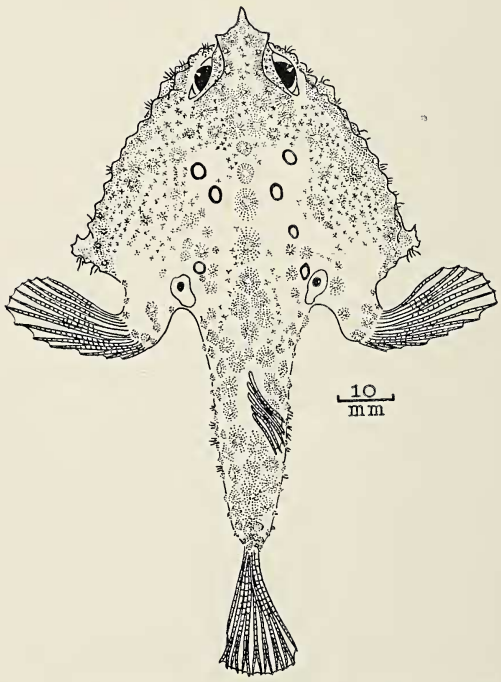

FIG. 7. Dorsal aspect of *Malthopsis annulifera* (specimen no. 19063, 85.5 mm. in standard length).

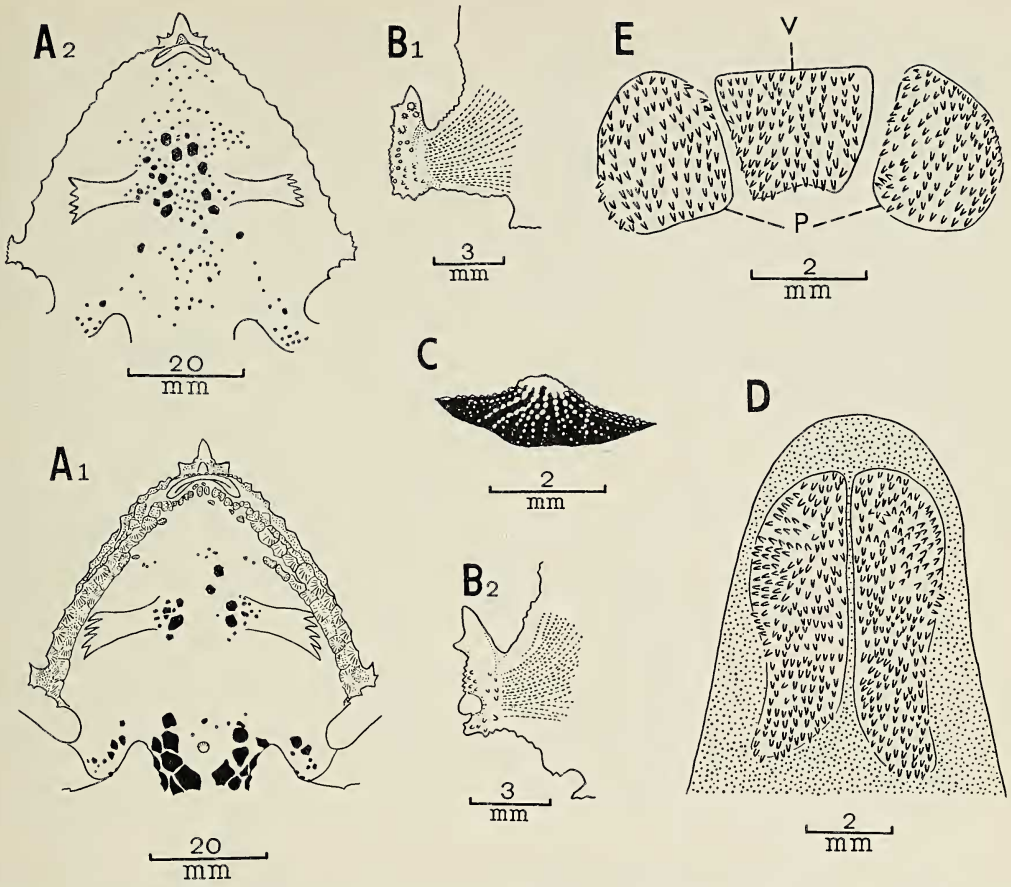

Fig. 8. *M. annulifera:* A_1, ventral aspect of disk; A_2, bony tubercles on ventral surface of disk; $B_{1,2}$, subopercular spine; C, lateral aspect of bony tubercle in median line of dorsal surface of disk; D, dorsal surface of anterior part of tongue; E, teeth on vomer (V) and palatine (P). A_1, from a specimen 85.5 mm. in standard length (specimen no. 19063); A_2, from a specimen, 72.0 mm. (specimen no. 20515); B_1, from a specimen, 77.0 mm. in standard length (specimen no. 17637); B_2, from a specimen, 75.0 mm. (specimen no. 9675); C, D, and E, from a specimen, 79.5 mm. (specimen no. 1630).

90.5 mm. (104.0–112.0 mm.), off Owasi, November 5, 1953.

No. 1993 (the number refers to Mie University Fish Collection) 85.0 mm. (105.5 mm.), off Owasi, September 21, 1950. No. 4421, 87.0 mm. (107.0 mm.), off Owasi, February 1952.

D. 4–5; A. 4; C. 8–9; P. 11–13; V. 1, 5. Disk length 1.73–1.98 (1.88) in standard length; disk width 1.05–1.47 (1.29); tail width 6.66–8.23 (7.37). Disk width 0.58–0.76 (0.68) in disk length; eye diameter 3.81–5.46 (4.86); interorbital width 6.00–8.72 (7.28); rostral spine 5.69–14.83 (9.66); mouth width 3.31–4.54 (3.94); pectoral fin 2.26–3.11 (2.74); pelvic fin 2.57–3.33 (3.05).

Disk broad, the greatest width somewhat less than length of body. Tail rather slender and short. Rostral spine about half as long as diameter of eye, directed forward or slightly upward.

Dorsal surface of disk covered with dermal ossicles except for both opercular and shoulder regions; some ossicles enlarged, moderately pointed, and quite regular in their arrangement; radial striations of bony tubercles prominent, and noticeably granulate (Fig. 8C); mediolateral rows represented by

two rather large tubercles, and joined to median row at anterior portion of disk; median row usually ending behind orbits, leaving a smooth space between orbits; three rows of tubercles running along the anterolateral margin of disk, the upper row turning sharply upward ventral of posterior rim of orbit. Ventral surface largely smooth, but sometimes armed with many ossicles between pelvic fins as in *M. jordani*, some of them enlarged, the tubercles, however, generally flattish and much smaller than those of the dorsal surface (Fig. $8A_1$, A_2). Tail rather sparsely surrounded with large bony tubercles.

Subopercular spine protruding, with a prominent antrorse spinule (Fig. $8B_1$, B_2).

Sides of body with many dermal cirri. Longest anal ray usually does not reach to base of caudal when the fin is laid back.

Patches of vomerine and palatine teeth rather large and roundish or quadrangular in shape (Fig. 8E); bands of teeth on tongue elongate, parallel, their posterolateral regions divergent (Fig. 8D).

Color, in formalin, yellowish brown above, furnished with 5 to 12 rather large black ring-like markings; striations of bony tubercles brown; under side of body pale; caudal and dorsal dusky, but other fins pale; peritoneum pale.

REMARKS: Specimens thus far examined agree in general with the original description of *Malthopsis annulifera* Tanaka (1908: 44), but differ from it in having a larger number of pectoral rays (12–14 instead of 8–9) and pointed bony tubercles on the ventral surface instead of flattish plates. Agreement of our specimens with those of *Malthopsis ocellata* Smith and Radcliffe (1912: 207–208, pl. 18, fig. 1, pl. 19, fig. 1) is evident inasmuch as they accord well with it in important features such as the dermal ossicles on body and the rostral and subopercular spines, but differ in that our specimens are provided with a larger number of anal rays (4 instead of 2).

Malthopsis lutea Alcock
Furyu-uo (Japanese name)
Figs. 9, 10

Malthopsis luteus Alcock, 1891: 26, pl. 8, figs. 2–2a; (*partim*) Okada and Matsubara, 1938: 458, pl. 113, fig. 1; Herre, 1941: 403; Mori, 1952: 195.

Malthopsis luteus (Alcock), Goode and Bean, 1895: 537, fig. 411.

Malthopsis lutea Alcock, 1899: 64–65, pl. 19, fig. 4; Kamohara, 1936*b*: 935; (*partim*) Kamohara, 1938: 76; Kamohara, 1950: 287; Kamohara, 1952: 103.

Malthopsis kobayashii Tanaka, 1916: 348.

MATERIAL EXAMINED: Nos. 976, 1635–1637, 47.0–60.0 mm. (60.5–78.0 mm.), off Owasi, Mie Pref., December 6–9, 1935. Nos. 4132–4133, 4292–4294, 4296 and 4679, 47.0–68.0 mm. (58.0–83.0 mm.), off Owasi, January 19, 1937. Nos. 6799–6802, 43.5–62.5 mm. (54.0–77.0 mm.), off Heta, Shizuoka Pref., November 22–24, 1938. Nos. 7053–7055 and 7075–

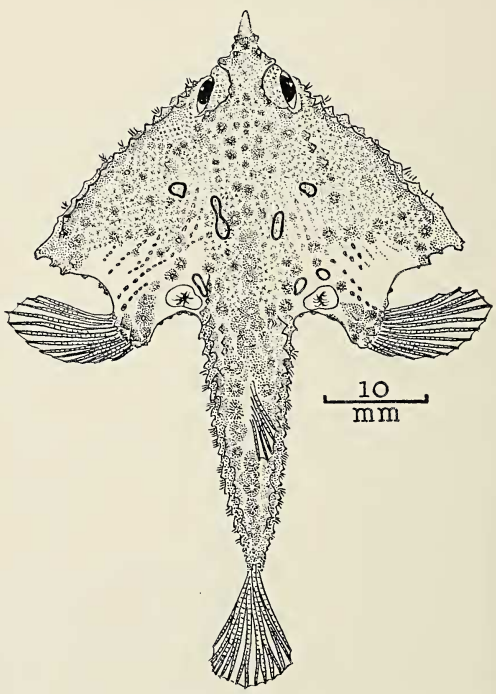

FIG. 9. Dorsal aspect of *Malthopsis lutea* (specimen no. 1637, 47.0 mm. in standard length).

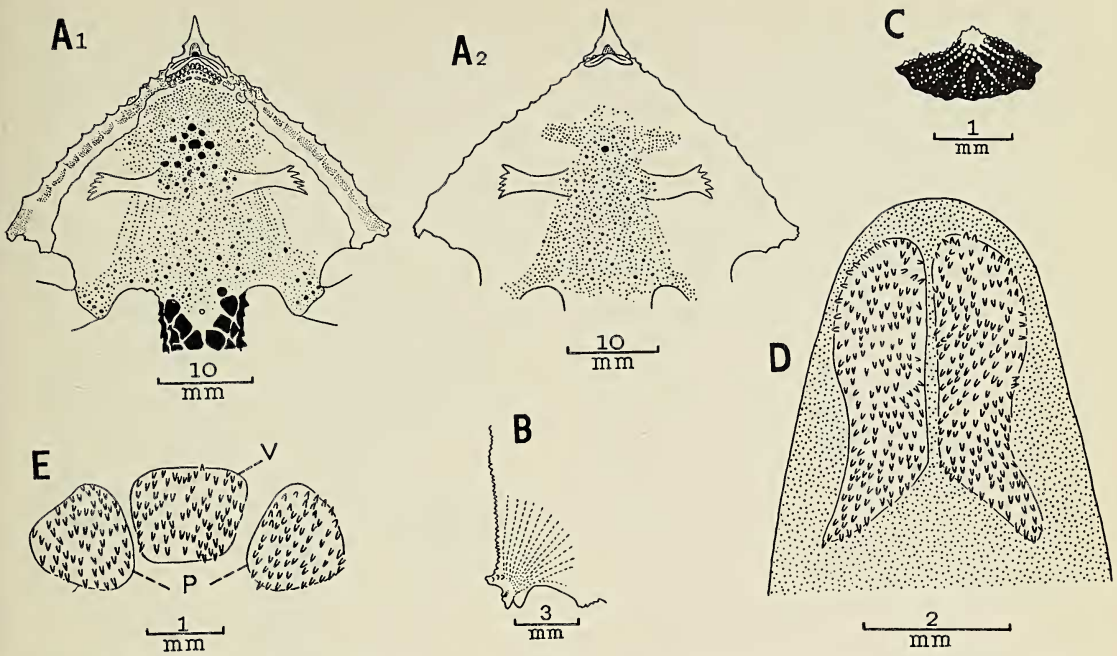

Fig. 10. *M. lutea:* A_1, ventral aspect of disk; A_2, dermal prickles on ventral surface of disk; B, subopercular spine; C, lateral aspect of bony tubercles on median line of dorsal surface of disk; D, dorsal surface of anterior part of tongue; E, teeth on palatine (P) and vomer (V). A_1, from a specimen, 47.0 mm. in standard length (specimen no. 1637); A_2, from a specimen 68.0 mm. in standard length (specimen no. 4294); B, from a specimen 55.0 mm. in standard length (specimen no. 7259); C, D, and E, from a specimen, 59.5 mm. (specimen no. 7054).

7076, 53.5–60.0 mm. (66.0–74.0 mm.), off Heta, November 24–25, 1939. No. 7259, 55.0 mm. (67.0 mm.), off Heta, January 6, 1940. No. 10368, 54.0 mm. (68.0 mm.), locality and date unknown. No. 15170, 60.0 mm. (76.0 mm.), off Owasi, January 18–20, 1950. No. 19201, 47.0 mm. (58.0 mm.), off Owasi, November 12–17, 1952. Nos. 20817–20820, 44.5–55.0 mm. (57.5–70.0 mm.), locality and date unknown. Nos. 21074–21075, 41.0–64.0 mm. (52.5–82.0 mm.), off Owasi, November 5, 1953.

No. 1992 (the numbers refer to Mie University Fish Collection), 62.5 mm. (78.0 mm.), off Owasi, September 21, 1950. Nos. 4420 and 4422–4423, 54.0–62.5 mm. (68.0–76.5 mm.), off Owasi, February, 1952.

D. 5–6; A. 4; C. 9; P. 11–12. V. 1, 5. Disk length 1.65–1.97 (1.79) in standard length; body width 1.08–1.44 (1.29); tail width 6.30–9.64 (7.73). Disk width 0.58–0.81 (0.71) in disk length; eye diameter 3.50–5.55 (4.48); interorbital width 6.79–10.00 (8.31); rostral spine 4.66–8.90 (6.63); mouth width 2.95–4.54 (3.88); pectoral fin 2.18–3.86 (2.73); pelvic fin 2.45–3.74 (2.99).

Disk broad, slightly narrower than length of body. Tail rather slender and short. Rostral spine more than half as long as diameter of eye, directed nearly horizontally forward.

Dorsal surface of disk thickly covered with dermal ossicles except for both opercular and shoulder regions; some ossicles enlarged, pointed and quite regular in their arrangement; radial striations of bony tubercles prominent and noticeably serrate (Fig. 10 C); mediolateral row represented by about 4 rather large bony tubercles and joined to median row of tubercles at the anterior part of disk; median row developed throughout the entire length of disk, but several tubercles between those of the mediolateral row smaller

than the posterior ones; occasionally, a number of tubercles scattered on both sides of mediolateral rows. Three rows of bony tubercles running along the antero-lateral margins of disk, the upper turning obliquely upwardly ventrad of posterior rim of eye. Ventral surface of disk, except for lateral regions, thickly covered with minute dermal prickles, some of them, more or less enlarged (Fig. 10 A_1, A_2). Tail rather completely surrounded with bony tubercles.

Subopercular spine directed outward and backward, armed at the tip with several minute teeth, but without a prominent antrorse spinule (Fig. 10B).

Sides of body with many dermal cirri. Longest anal ray reaches to base of caudal when the fin is laid back.

Patches of vomer and palatine teeth rather large and quadrangular or circular (Fig. 10E); bands of teeth on tongue elongate, parallel, the posterolateral regions greatly divergent (Fig. 10D).

Color, in formalin, yellowish brown above; pale below; striations of dorsal bony tubercles brown; upper surface of disk sometimes furnished with 2 to 8 large ring-like markings; these markings, however, entirely absent in half of our specimens; caudal, pectoral and dorsal dusky, but the other fins pale; peritoneum also pale.

REMARKS: The specimens belonging to the types V (with the arrangement of the dorsal armature on body irregular and the disk width narrow) and Y (with the dermal armature irregular and the disk width medium) of Lloyd (1909: 175–176, pls. 48–49) are contained within this species.

Malthopsis tiarella Jordan
Goma-furyu-uo (Japanese name)
Fig. 11

Malthopsis tiarella Jordan, 1902: 378–379, fig. 7; Jordan and Starks, 1904: 628; (*partim*) Jordan, Tanaka, and Snyder, 1913: 428, fig. 396; (*partim*) Tanaka, 1931: 43; ?Kamohara, 1934*b*: 1202; ?Oshima, 1938: 285; Kamohara, 1950: 288; Kamohara, 1952: 104.

MATERIAL EXAMINED: No. 4679, 51.5 mm.

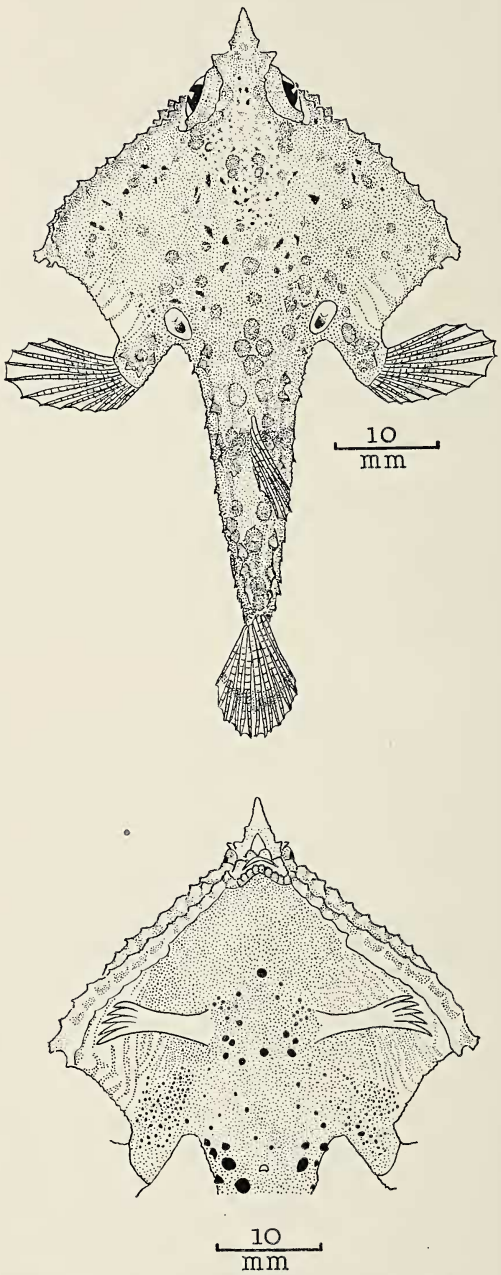

FIG. 11. *Malthopsis tiarella:* Upper figure, dorsal aspect (specimen no. 4679, 515 mm. in standard length); lower figure, ventral aspect of disk (specimen no. 4679, 51.5 mm. in standard length).

(64.5 mm.), off Owasi, Mie Pref., January 19, 1937. No. 22068, 37.0 mm. (47.0 mm.), Mimase, Kôchi City, April 10, 1954.

D. 6; A. 3–4; C. 8–9; P. 12; V. 1, 5. Disk length 1.71–1.76 in standard length; disk width 1.31–1.33; tail width 6.70–7.35. Disk width 0.75–0.76 in disk length; eye diameter 4.20–4.60; interorbital width 6.00–7.92; rostral spine 5.20–6.52; mouth width 4.75–5.00; pectoral fin 1.91–2.85; pelvic fin 2.47–3.08.

Disk broad, but narrower than length of body. Tail rather slender and short. Rostral spine nearly porrect, more than half as long as diameter of eye.

Dorsal surface of disk thickly covered with dermal ossicles except for opercle; some of them enlarged, strongly pointed and regular in their arrangement; radial striations of the tubercles prominent and sharply serrate; mediolateral rows each represented by 2–3 rather large tubercles, joining median row at middle of disk; area of forehead between mediolateral rows without any prominent median tubercles. Three rows of tubercles running along the anterolateral margin of disk, the upper row sharply turning obliquely upward ventrad of posterior rim of orbit; the middle row represented by 4 large tubercles, inconspicuous tubercles scattered between the middle and lower rows. Ventral surface of disk almost entirely covered with minute bony prickles, some of them more or less enlarged (Fig. 11). Tail completely surrounded with large and small tubercles.

Subopercular spine directed outward and backward, armed with several minute serrations, but without any prominent spinules.

Lateral sides of body without dermal cirri. Longest anal ray reaches to base of caudal when the fin is laid back.

Patches of vomerine and palatine teeth rather large and quadrangular.

Color, in formalin, brownish above, with irregular blackish brown specks; back and side of tail crossed with black bars at the base of dorsal and caudal; pale below; a dark bar crossing near the end of caudal; pectoral and pelvic dusky; anal pale.

REMARKS: It should be noted that *Malthopsis tiarella* is shown in Jordan's figure (1902, fig. 7) with more numerous pectoral and caudal rays than those given by Jordan in his original description of this species (14 and 9 respectively instead of 10 and 6). We are inclined to regard these discrepancies partly as Jordan's miscounting and partly as draughtsman's errors. Although the dorsal rays are somewhat fewer in our two specimens than in the holotype (6 instead of 7), the agreement in other various important features between our specimens and the holotype are beyond doubt. The species is most closely related to *Malthopsis lutea* Alcock, but may be distinguished from it by the following features: bony tubercles on dorsal surface forming two rows on forehead; upper surface of disk provided with blackish brown irregular specks; dorsal rays six or seven.

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